VERIFICATION OF TRANSLATION

I, Yoshihiko SHIMAZOE of

2-17, Sotokanda 2-chome, Chiyoda-ku, Tokyo, Japan,

hereby declare that I am the translator of the specification, claims and drawings of

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filed in Japan on July 31, 2002 and that the attached English document is a true and correct translation thereof to the best of my knowledge and belief.

Yoshihiko SHIMAZOE

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【Inventor】
【Address】 16-9, Maimatsubara 3-chome, Higashi-ku, Fukuoka-shi, Fukuoka-ken, JAPAN
【Name】 MATSUFUJI, Yasunori
【Applicant】
【Identification Number】 396020800
【Name】 JAPAN SCIENCE AND TECHNOLOGY CORPORATION
【Agent】
【Identification Number】 100094835
【Patent Attorney】
【Name】 SHIMAZOE, Yoshihiko
【Telephone Number】 03-5295-6648
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METHOD FOR PLANNING CONSTRUCTION OF BRICK WALL

【Set of Claims】

【Claim 1】

A method for planning construction of a brick wall made by a dry type of construction method, in which the brick wall is constructed from bricks, bolts, nuts and metal plates and in which the bricks are integrally assembled under pre-stress by tightening forces of the bolts and nuts,

wherein the brick has a dimensional proportion which is 1:2 in an aspect ratio, a bolt hole with a diameter smaller than an external diameter of said nut vertically extends through a center of a first square half part of said brick, a hollow section for containing the nut vertically extends through a center of a second square half part of said brick, and said bolt has an overall length for fastening the vertically adjacent two bricks, comprising the steps of:

specifying a grid pattern XY coordinate system forming square grids, each of the grids substantially conforming to a planar size of the square half part of said brick, and setting odd number layer tightening grids (α) and even number layer tightening grids (β) alternately in each of X- and Y- directions;

setting an arbitrary grid, to which an end part of the brick wall is allotted, to be a reference grid (γ);

positioning the brick of the end part of the brick wall on said reference grid for allocating the bricks in the odd number layer so as to match said first square half part to said odd number layer tightening grid, and successively arraying the bricks of the odd number layer from the brick on the reference grid, as well as positioning the brick of the end part of the brick wall on said reference grid for allocating the bricks in the even number layer so as to match said first square half part to said even number layer tightening grid, and successively arraying the bricks of the even number layer from the brick on the reference grid; and

arraying said metal plates for allocation of the plates on the bricks of said odd number layer so that at least one bolt hole of the plate is positioned on said odd number layer tightening grid, as well as arraying the metal plates for allocation of the plates on the bricks of said even number layer so that at least one bolt hole of the plate is positioned on said even number layer tightening grid.

【Claim 2】

A method as defined in claim 1, wherein said metal plate has two, three, four or five bolt holes, which are spaced from each other, a distance corresponding to the planar dimension of said square half part.

【Claim 3】

A method as defined in claim 1 or 2, wherein said nuts for the bricks of the odd number layer are allotted to the bolt holes of said metal plates located on the odd number layer tightening grid, and the nuts for the bricks of the even number layer are allotted to the bolt holes of said metal plates located on the even number layer tightening grid.

【Claim 4】

A method as defined in one of claims 1 to 3, wherein a corner of the brick wall positioned at a corner of an architecture is allotted to said grid, so that the said reference grid (γ) is determined.

【Claim 5】

A method as defined in one of claims 1 to 4, wherein quantities of the bricks, the bolts, the nuts and the metal plates are estimated, based on the number of grids locating along the brick wall.

【Claim 6】

A brick wall of a building which is constructed in accordance with the brick allocation and the plate allocation determined by the method as defined in one of claims 1 to 6, so that said bolts and nuts are contained in said bolt holes and said hollow sections.

【Detailed Description of the Invention】

【0001】

【Field of the Invention】

The present invention relates to a method for planing construction of a brick wall, and more specifically, to such a method for a dry type of bricklaying construction method in which vertically adjacent bricks are integrally assembled under pre-stress by stacking the bricks and metal plates and tightening nuts and bolts extending through bolt holes of the bricks.

【0002】

【Prior Art】

A variety of building construction methods are known in the art, such as wooden, reinforced concrete, steel and block masonry construction methods. As a kind of such construction methods, a bricklaying method is known, in which a wall structure is constructed by bricklaying. Bricks produced by baking brick clay at a high temperature are evaluated high by their architectural design effects or aesthetic effects resulting from their textures, stately appearances, feelings, colors and so forth. The bricks also exhibit their excellent physical performances with respect to durability, sound insulation effect, fire resistance efficiency, heat accumulation effect and so forth. Therefore, the bricks have been popularly used worldwide for a long time and widely employed as materials for architectural wall structures.

【0003】

The present inventor has proposed DUP (Distributed and Unbonded Prestress) construction method as a dry type of bricklaying construction method. This construction method is known as an earthquake resistant bricklaying construction method in which bricks are stacked in a multi-layered condition while pre-stress is introduced into the bricks by tightening forces of metallic bolts. Studies for practical applications thereof is still continued (Japanese patent applications Nos. 4-51893, 5-91674, 6-20659, 7-172603 and 8-43014).

【0004】

With respect to the such a bricklaying construction method, the present inventor has proposed the method in which a bolt hole, a large

diameter hollow section and semicircular grooves on end faces are formed in position of a brick so that various intricate parts of wall structures can be constructed by a common type of bricks, in Japanese patent application No. 2000-270219 (Japanese patent laid-open publication No. 2002-81152).

【0005】

【Problems to be solved by the Invention】

The dry type of bricklaying construction method as set forth above is a dry construction method in which a brick wall is constructed by tightening forces of bolts and nuts, and this method has achieved an intended purpose, such as considerable reduction of time of construction period, in comparison with a conventional wet type of bricklaying construction method. On the other hand, in this construction method, it is necessary to optimize not only allocations of bricks but also allocations of metal plates, bolts and nuts in each of the brick layers, because the structure is arranged so that the strength of wall depends on the tightening torque of the bolt and nut which is transmitted as a stress to the brick through the metal plate. Accordingly, the allocations and the arrangements of bricks, plates, bolts and nuts in plans and elevations, and the like, should be accurately and promptly determined before construction or during construction, in order to make elevations of brick allocations, plans of allocations of brick and plate in regard to each of layers, and so forth. However, an allocating rule for systemizing and optimizing layout of the bricks, the metal plates, and the bolts and nuts in the DUP construction method has not yet been established, and therefore, construction planning method for establishing the rule is desired to be developed.

【0006】

Further, the walls of building includes not only regular and straight wall structures but also peculiar configurations or irregularly deformed parts, such as ends, corners and connections of wall structures, openings of windows or doors, external or internal corners of partition

walls, and so forth. Therefore, it is necessary to produce various plates, taking such irregular parts into consideration. For this reason, it is difficult to prepare and stock the plates beforehand, and the construction period in the construction site may be affected by a term of time (days) for manufacture of the plates, timing of an order of the plates, or the like.

【0007】

Furthermore, since the bolts and nuts are positioned at vertical joints in the conventional bricklaying method, it is necessary to surely isolate the bolts and nuts from outdoor air and ensure rustproofing, weatherproofing, fireproofing and the like for the bolts and nuts and their surrounding structures. In order to omit or simplify such additional treatments, it is desired to adopt a design in which the bolts and nuts can be entirely contained in the bricks without the bolts and nuts being positioned at the vertical joints and in which tightening forces of bolts and nuts can be uniformly distributed over the whole wall so as not to make structural weak points. However, it is difficult to perform such a design in the bricklaying construction method in which the layout plans of bricks and plates are required for each of the layers as set forth above, and therefore, development of construction planning method is desired for performing such a design simply, promptly and systematically.

【0008】

It is an object of the present invention to provide a method for planning the construction of the brick wall based on the DUP construction method, which can accurately, promptly and systematically determine the allocations of the bricks, the plates and the bolts and nuts before construction or during construction for constructing an arbitrary brick wall with use of a few standardized types of plates, which allows the bolts and nuts to be contained in the bricks, and which allows the tightening forces of the bolts and nuts to be distributed uniformly throughout the overall walls.

【0009】

【Means for solving the problem】

The present invention provides a method for planning construction of a brick wall made by a dry type of construction method, in which the brick wall are constructed from bricks, bolts, nuts and metal plates and in which the bricks are integrally assembled under pre-stress by tightening forces of the bolts and nuts,

wherein the brick has a dimensional proportion which is 1:2 in an aspect ratio, a bolt hole with a diameter smaller than an external diameter of said nut vertically extends through a center of a first square half part of said brick, a hollow section for containing the nut vertically extends through a center of a second square half part of said brick, and said bolt has an overall length for fastening the vertically adjacent two bricks, comprising the steps of:

specifying a grid pattern XY coordinate system forming square grids, each of the grids substantially conforming to a planar size of the square half part of said brick, and setting odd number layer tightening grids (α) and even number layer tightening grids (β) alternately in each of X- and Y- directions;

setting an arbitrary grid, to which an end part of the brick wall is allotted, to be a reference grid (γ);

positioning the brick of the end part of the brick wall on said reference grid for allocating the bricks in the odd number layer so as to match said first square half part to said odd number layer tightening grid, and successively arraying the bricks of the odd number layer from the brick on the reference grid, as well as positioning the brick of the end part of the brick wall on said reference grid for allocating the bricks in the even number layer so as to match said first square half part to said even number layer tightening grid, and successively arraying the bricks of the even number layer from the brick on the reference grid; and

arraying said metal plates for allocation of the plates on the bricks of said odd number layer so that at least one bolt hole of the plate is positioned on said odd number layer tightening grid, as well as arraying the metal plates for allocation of the plates on the bricks of said

even number layer so that at least one bolt hole of the plate is positioned on said even number layer tightening grid.

【0010】

In the brick wall made by the DUP construction method, the brick has a particular planar size (the aspect ratio is 1:2). At the center of each half part of the brick, one of the bolt hole or the hollow section is located. In the brick wall made by the DUP construction method, the bolt can be set to have an overall length for tightening vertically adjacent two bricks and the tightening positions of the nuts can be positioned elevationally alternately and systematically. According to such regularity and particularity of the DUP construction method, when the half part of the brick is recognized as a grid in a plan, the grid of the even number brick layer immediately under or above the grid of the odd number brick layer indicates a position unnecessary for tightening the nut if the grid of the odd number brick layer indicates a position necessary for tightening the nut, and vice versa. Therefore, if a grid plan is specified and a corner part of a brick wall is allotted to an arbitrary grid in the grid plan, the allocation of bricks can be systematically determined for the entire building. In addition, as the bolt hole of the metal plate corresponds to the bolt hole of the brick immediately below the metal plate, the allocation of metal plates in the respective layers can be systematically determined in association with the allocation of the bricks in the respective layers.

【0011】

Thus, according to the aforementioned method of planning construction of the brick wall, it is possible to accurately, promptly and systematically determine the allocations of the bricks, the plates, and the bolts and nuts regardless of whether it depends on manual operation or mechanical means. Further, since the allocation of the metal plates can be also systematically carried out, the metal plates can be also standardized beforehand in correspondence to the allocation rule of the bricks. Therefore, the brick walls can be constructed with use of a few

types of standardized metal plates previously manufactured or stocked. Furthermore, according to the aforementioned method, the bolts and nuts are contained in the bricks without being located at the joint parts of the bricks, so that the bolts and nuts are isolated from the external environment. Therefore, durability and fire resistance of the bolts and nuts can be improved. In addition, the bolts and nuts are uniformly disposed to the overall brick walls, and therefore, the tightening forces of the bolts and nuts are uniformly distributed over the whole brick wall.

【0012】

From another aspect of the present invention, a brick wall of a building is provided, which is constructed on the basis of the brick allocation and the plate allocation settled in accordance with the present method, and the bolts and nuts are contained in the bolt holes and the hollow sections.

【0013】

【Embodiments of the invention】

According to an preferred embodiment of the present invention, the aforementioned metal plate has two, three, four or five bolt holes, which are spaced from each other, a distance corresponding to the planar dimension of the aforesaid square half part. The nuts for the bricks of the odd number layer are allotted to the bolt holes of the metal plates located on the tightening grid of the odd number layer, whereas the nuts for the bricks of the even number layer are allotted to the bolt holes of the metal plates located on the tightening grid of the even number layer. Preferably, a corner part of an outer brick wall located on a corner of building is allotted to an arbitrary grid in the XY coordinate system, so that the aforesaid reference grid (γ) is determined.

【0014】

According to yet another embodiment of the present invention, quantities of the bricks, the bolts, the nuts and the metal plates are estimated, based on the number of grids locating along the brick wall.

【0015】

Preferably, the method as set forth above is carried out by a computer program (software) comprising:

means for defining a grid pattern XY coordinate system constituted from square grids, each being substantially conforming to the planar size of a square half part of the brick, and setting odd number layer tightening grids (α) and even number layer tightening grids (β) alternately in each of X- and Y- directions;

means for setting the arbitrary grid on the XY coordinate system to which an end part of the brick wall is allotted, to be a reference grid (γ);

odd number layer brick allocation means for positioning the brick at the corner of the wall to be located on the reference grid in such a manner that a first half part of the brick matches the odd number layer tightening grid, and successively arraying the bricks of the odd number layer from the brick on the reference grid;

even number layer brick allocation means for positioning the brick at the corner of the wall to be located on the reference grid in such a manner that the first half part of the brick matches the even number layer tightening grid, and successively arraying the bricks of the even number layer from the brick on the reference grid;

odd number layer metal plate allocation means for arraying the metal plate in such a manner that at least one bolt hole of the plate is positioned on the odd number layer tightening grid; and

even number layer metal plate allocation means for arraying the metal plate in such a manner that at least one bolt hole of the plate is positioned on the even number layer tightening grid.

【0016】

More preferably, the computer program further comprises brick layout drawings production means for producing brick layout plan drawings in the respective brick layers; plate layout drawings production means for producing plate layout plan drawings in the respective brick layers; and estimation means for estimating quantities

of the bricks, the bolts, the nuts and the metal plates.

【0017】

【Embodiments】

With reference to the attached drawings, preferred embodiments of the present invention are described hereinafter.

FIG. 1 is a schematic cross-sectional view of a house provided with brick walls made by the DUP construction method.

【0018】

The building is generally constructed from a foundation and floor slab 1, outer walls 2, inner walls 3, a second floor structure 5, ceilings 6, a roof structure 4 and roofing materials (not shown). The outer wall 2 consists of a brick wall which has bricks 10 laid in accordance with the DUP construction method. The inner wall 3 is constructed from wooden panels which are used in a two-by-four construction method, and it is built on the foundation and floor slab 1. The roof structure 4 is supported by an upper edge of the inner wall 3, and the roofing materials are provided on an upper surface of the roof structure 4. A load of the roof structure 4 acts on the inner wall 3 as a vertical load, which are supported by a load carrying capacity of the inner wall 3.

【0019】

An outer end portion of a shearing reinforcement metal 7 is secured to an upper end portion of the outer wall 2, and the metal 7 extends horizontally toward the inner wall 3. An inner end portion of the metal 7 is bent downward at a right angle and connected to the upper end portion of the inner wall 3. The horizontal load (seismic force and so forth) acting on the roof structure 4 and the inner wall 2 is transmitted to the outer wall 2 by means of the metal 7 and it is supported by resistance of the outer wall 2 against earthquake. The second floor structure 5 and the upstairs inner wall 3 are supported by horizontal members 9. Shearing reinforcement means 8 for an intermediate floor interconnects the horizontal members 9 and the outer wall 2 for

transmission of stress.

【0020】

FIGS. 2 and 3 are illustrations of two types of bricks, each showing a plan, a front elevation, a cross-section and perspective views of the brick. FIGS. 4, 5, 6 and 7 are cross-sectional views, perspective views and an elevational view, which show a bricklaying method.

【0021】

The first brick 10A as shown in FIG. 2 is an integrally formed product made from clay by high temperature baking, which is configured generally in a form of rectangular prism. The brick 10A is provided with a raised portion 12 on its front and rear faces. Vertical large diameter hollow sections 20 and a vertical bolt hole 30, each having a circular cross-section, are aligned in a widthwise direction of the brick 10A, and they extend through the brick 10A, respectively. Each of centers of the large diameter hollow sections 20 and the bolt hole 30 is positioned on a center line of the brick 10A, and the centers are spaced an equal distance (b) from each other in a direction of the width (W) of the brick 10A. The bolt hole 30 is positioned at a center of one half part of the brick 10A (the left half as seen in the figure), and the hollow section 20 is positioned at a center of the other half part of the brick 10A (the right half as seen in the figure).

【0022】

The second brick 10B as shown in FIG. 3 is a brick in a form of rectangular prism, which is produced by the same raw material and the same method as those of the first brick 10A. Similarly to the first brick 10A, the second brick 10B is provided with the vertical large diameter hollow sections 20 and the vertical bolt hole 30 having circular cross-sections, which are aligned on the center line and spaced an equal distance from each other. The bolt hole 30 is positioned at a center of one half part of the brick 10B (the left half as seen in the figure), and the hollow section 20 is positioned at a center of the other half part of the brick 10B (the right half as seen in the figure), in the same manner as

that of the brick 10A. The brick 10B differs from the first brick 10A in that the raised portions 12 are provided on its front, rear, both end, top and bottom faces, respectively.

【0023】

The dimensions (mm) of the bricks 10A, 10B, the bolt hole 30 and the hollow section 20 in this embodiment are set to be as follows:
Width W, Depth D and Height H of the brick; 220mm×110mm×85mm
Locations a, b of the centers of the bolt hole and the hollow section; 55mm, 55mm
Diameter d1, d2 of the bolt hole and the hollow section; 16mm, 40mm

【0024】

As is apparent from these values of size, the brick 10A, 10B have a proportion of an aspect ratio of 1:2 (planar dimensional ratio), and its half part has a square configuration in the plan view.

【0025】

Steps of a bricklaying work are shown in FIG. 4. As shown in FIG. 4, a metal plate 50 is interposed between a first layer A of the bricks 10 and a second layer B thereof. Bolt holes 53 of the plate 50 are in alignment with the hollow section 20 and the bolt hole 30. A fully screw-cut bolt 60A, which has a height (length) equivalent to the height of two-layered bricks, extends through the hollow section 20 and the bolt holes 30, 53, and a long nut 70 engageable with the bolt 60A is positioned in a hollow area 21 of the hollow section 20. A lower end portion of the bolt 60A is screwed into the nut 70 and tightened thereto.

【0026】

The plate 50 is positioned on an upper surface of the brick 10 (the first layer A; the second layer B) which has been already laid in position, and a circular washer 63 and a spring washer 62 are positioned on the plate 50 so as to be in alignment with the bolt hole 53. The bolt 60A extends through the bolt hole 53 and the washers 63, 62 to protrude upwardly, and an inside screw 71 of the nut 70 is screwed on an upper end portion of the bolt 60A.

【0027】

A specific fixing tool 100 as illustrated by phantom lines in Fig. 2 is used for tightening the nut 70 onto the bolt 60B. The fixing tool 100 is provided with a portable driving part 101, a socket part 102 selectively engageable with the bolt 60 and the nut 70, and a joint part 103 which can integrally connect the proximal portion of the socket 102 with a rotary shaft 104 of the driving part 101. The socket part 102 receives the nut 70 so as to transmit the torque of the part 101 to the nut 70, thereby rotating the nut 70 in its tightening direction. The nut 70 rotates relatively to the bolt 60A to be securely tightened on the upper end portion of the bolt 60A.

【0028】

In a succeeding bricklaying step, the brick 10 for an upper layer (the third layer C) is further laid on the lower layer brick B. The nut 70 is contained in the hollow section 20, and the metal plate 50 is laid on the brick C, and then, the bricks 10 of a further upper layer (the fourth layer D) is laid on the plate 50. A bolt 60B is inserted into the bolt hole 30 of the uppermost brick 10 (the fourth layer D), and the lower end portion of the bolt 60B is screwed into the nut 70. The aforementioned fixing tool 100 is used for tightening the bolt 60B to the nut 70. That is, the socket part 102 of the tool 100 receives the upper end portion of the bolt 60B to transmit the torque of the driving part 101 to the bolt 60B, so that the bolt 60B is rotated in its tightening direction. As the result, the bolt 60B is securely tightened to the nut 70.

【0029】

The brick-laid condition of the bricks 10 (the first to fourth layers A:B:C:D) thus constructed is shown in FIGS. 5 and 6. Tensile stress corresponding to the tightening torque acts as pre-stress on the bolt 60, upper and lower end portions of which are engaged with the nuts 70, and compressive stress acts as pre-stress on the brick between the upper and lower plates 50. The torque applied to the bolt 60 and the nut 70 in the upper layer by the tool 100 transmits to the bolt 60 and

the nut 70 of the layer immediately thereunder, and acts to further tighten the underside bolt and nut. Therefore, a series of connected bolts 60 and nuts 70 functions in such a manner that the tightening torque of the upper bolts 60 and nuts 70 is transmitted to the lower bolts 60 and nuts 70, and that the lower bolts 60 and nuts 70 are further tightened by a stronger tightening torque as the bricks 1 are laid in the upper layers. This results in that the pre-stress of a considerably high strength acts on the bolts 60 and the bricks 1 residing in the lower layers, and therefore, that the rigidity and toughness of the wall are considerably improved against the horizontal and vertical exciting forces.

【0030】

FIG. 7(A) is a perspective view showing the steps of further assembling the plate 50, the washers 63, 62 and the nut 70 on the brick 10 of the fourth layer D. The steps as shown in FIG. 4 are repeatedly carried out for the upper layers above the bricks C:D, whereby a continuous wall (an outer wall or an interior partition wall of a building) having a dry construction type of bricklaying structure is constructed, which comprises the bricks integrally tightened by the fastening elements 60; 62; 63; 70.

【0031】

FIG. 7(B) is a horizontal cross-sectional view showing an array of bricks in an even number layer B, D, whereas FIG. 7(C) is a horizontal cross-sectional view showing an array of bricks in an odd numbered layer A, C. As illustrated in the respective views, the nut 70 inserted into the hollow section 20 and the bolt 60 inserted through the bolt hole 30 are spaced apart an equal distance (2b) from each other and are alternately arrayed on the center line of the brick wall.

【0032】

If desired, horizontal and vertical joints formed between the upper and lower bricks 10 or between the horizontally adjacent bricks 10 are filled with joint filler such as a sealing compound.

FIG. 8 is a perspective view showing an arrangement of the bricks at a corner part of brick wall, FIG. 9 is a perspective view showing an arrangement of the bricks at a T-shaped connection of brick walls, and FIG. 10 is a perspective view showing an arrangement of the bricks around an opening 200 for a door, window or the like.

【0033】

As shown in FIG. 8, the corner of brick wall has a structure in which the bricks 10B (FIG. 3) oriented at a right angle are alternately laid. The hollow section 20 and the bolt hole 30 of the bricks 10B are vertically alternately arrayed. Straight bricklaying walls constructed from the bricks 10A (FIG. 2) extend at a right angle from the corner part.

【0034】

In FIG. 9, a wall joint part is exemplified, in which straight bricklaying walls constructed from the bricks 10A (FIG. 2) are connected to each other in a form of letter "T". Generally, half bricks 10C are used at the joint part of the intersecting walls.

【0035】

In FIG. 10, a wall structure surrounding the opening 200, such as an opening for a window or a door, is exemplified. The brick wall around the opening has an irregular arrangement in which the bricks 10A (FIG. 2) and the bricks 10B (FIG. 3) at a right angle are appropriately incorporated.

【0036】

FIGS. 11 and 12 are plan views showing arrangements of the metal plates 50 in a brick wall provided with such a wall joint part and an opening for a door or window as set forth above.

A two-holes plate 50' having a pair of holes 53 is shown in FIG. 11(A), and a three-holes plate 50" having three holes 53 is shown in FIG. 12(A). A condition is illustrated in FIG. 11 (C) in which the plates 50' are disposed on the brick wall as shown in FIG. 11(B), and a condition is shown in FIG. 12(B) in which the plates 50" are mainly disposed on the brick wall as shown in FIG. 11(B).

【００３７】

The bolt hole 30 of the brick 10 should be located below at least one bolt hole 53 of the plate 50', 50", and the nut 70 should be tightened to the upper end portion of the bolt 60 extending through this bolt hole 53. However, if the types of metal plates 50 are limited to, e.g., only two types (the plates 50', 50"), it would be difficult to determine proper locations of the plates and proper positions of the bolts in the parts having a peculiar or deformed configurations, such as the openings 200 for doors or windows, projected or recessed corners of interior partition walls (interior walls), or the like.

【００３８】

FIG. 13(A) is a plan view illustrating an XY coordinate system for systematical and accurate setting of positions of the bricks, the metal plates and the bolt and nut. FIG. 13 (B) is a partially enlarged view of the XY coordinate system as shown in FIG. 13(A). It may be understood or comprehended that this XY coordinate system is a template for accurately positioning the bricks, the metal plates and the bolt and nut.

【００３９】

An X-axis and a Y-axis of the XY coordinate system intersect at a right angle, and square grids are defined in the coordinate system by the lines extending in X-axis and Y-axis directions, each of the grids having dimensions of one half of the brick 10, i.e., b×b (in this embodiment, 110mm×110mm). The grids are classified into odd number layer tightening grids α and even number layer tightening grids β. The grids α, β are alternately positioned in the X-direction and the Y-direction respectively, and a checkered grid pattern is dimensionally uniformly formed over the whole coordinate system.

【００４０】

As a corner part of the brick wall is positioned at an arbitrary grid γ as shown in FIG. 13 (B), allocation of the bricks, allocation of the plates and positioning of the bolts can be set systematically for the

overall building, on the basis of the grid γ.

【0041】

With reference to FIGS. 14 and 15, a method for making layout of the bricks and the plates is described hereinafter.

In FIG. 14, a process of allocating the bricks and the plates in the odd number layers such as the aforementioned bricks A; C (FIG. 6). In FIG. 15, a process of allocating the bricks and the plates in the even number layers such as the aforementioned bricks B; D (FIG. 6).

【0042】

The allocation of the bricks in the odd number layers is carried out by allotting a corner of the brick wall to the reference grid γ and successively allocating the bricks 10 in accord with a planning of the whole building, as shown in FIG 14 (A), whereby a layout plan or planar distribution map of the bricks corresponding to the building plan can be made in regard to the odd number layers. Simultaneously, the metal plates 50 are allocated successively from the reference grid γ in correspondence to the layout plan of the bricks for the odd number layers as shown in FIG. 14 (B), so that a layout plan or distribution map of the metal plates for the odd number layers is made in correspondence to the layout plan of the bricks for the odd number layers. In this embodiment, the two-holes plates 50' are mainly used as the metal plates 50.

【0043】

The bricks 10 and the plates 50 are allocated on the allocating condition that the bolt holes 30 are positioned at the odd number layer tightening grids α and that at least one bolt hole 53 of the plate 50 is positioned in the odd number layer tightening grid α.

【0044】

As shown in FIG 15 (A), the allocation of the bricks in the even number layers is carried out by allotting the corner of the brick wall to the reference grid γ and successively allocating the bricks 10 in accord with the planning of the whole building, similarly to the allocation of the bricks in the odd number layers, whereby a layout plan or planar

distribution map of the bricks corresponding to the building plan is made in regard to the even number layers. The allocation of the bricks in the even number layer differs from that of the odd number layer in that the allocation is determined on the condition that the bolt holes 30 are disposed on the even number layer tightening grid β. Simultaneously, the metal plates 50 are allocated successively from the reference grid γ in correspondence to the layout plan of the bricks for the even number layers as shown in FIG. 15 (B), so that a layout plan or distribution map of the metal plates for the even number layers is made in correspondence to the layout plan of the bricks for the even number layers.

【0045】

FIG. 16 is a flowchart showing the operation for systematically setting the allocation of the bricks, the allocation of the plates and the positions of the bolts for the whole building with use of the aforementioned coordinate system.

【0046】

As a plan of the building is fixed by planning of the owner of the building, an architect and the like, positional information of the respective parts of the wall including information of openings and the like is applied to the aforementioned XY coordinate system, whereby an elevational brick layout is determined, and therefore, the elevational brick layout drawings can be drafted. Simultaneously, the wall plan is developed in each of the layers or steps for settling the wall plan of each layer or step including the brick layout information and the plate layout information. The bolt holes 30 in the odd number layer are positioned in the odd number layer tightening grids α, whereas the bolt holes 30 in the even number layer are positioned in the even number layer tightening grids β. The profile of brick and so forth is determined. Thus, the brick layout plan in each of the layers can be made.

【0047】

As regards the metal plates 50, the bolt holes 53 of the plates 50 in the odd number layers are positioned in the odd number layer

tightening grids α, and the bolt holes 53 of the plates 50 in the even number layers are positioned in the even number layer tightening grids β, whereby the basic allocation of the plates 50 is made. If desired, study, replacement or the like are conducted with respect to specific parts of the plates. Thus, the plate layout plan can be made in each of the layers.

【0048】

Programming of the flow of operation as shown in FIG. 16 is conducted by information processing technology, and if desired, cooperation or plug-in with a drafting software, such as a CAD software, whereby a computer program for allocation specialized to the DUP construction method can be made with respect to the bricks, the plates and the bolts. Further, quantities of the bricks, the plates, the bolts and so on required for construction of the building can be automatically estimated by information processing of the various data of such a computer program for allocation.

【0049】

As set forth above, according to the aforementioned method (grid method) for allocating the bricks, plates and bolts with use of the grid plan, allocation and so forth for the bricks 10, plates 50, bolts 60 and nuts 70 can be determined accurately, simply, promptly and systematically before construction or during construction by means of the odd number layer tightening grids α in the odd number layers and the even number layer tightening grids β in the even number layers. In accordance with such a grid method, optimized design with use of a few types of metal plates can be performed by means of systematic and simple human work or mechanical work, and therefore, the types of metal plates can be restricted. Thus, standardized production of the metal plates and stock of them are possible. Further, use of the aforementioned grid method allows substantially all of the bolts and nuts to be contained in the hollow sections 20 and the bolt holes 30 of the bricks 10, and therefore, weather resistance, fire resistance and the like of the bolts and nuts are improved. In addition, the bolts and nuts are uniformly distributed over the entire

brick walls, so that the effects of tightening forces of the bolts and nuts can be uniformly given to the overall walls.

【0050】

Although the present invention has been described as to specific embodiments, the present invention is not limited to such embodiments, but may be modified and changed without departing from the scope of the invention as claimed in the attached claims.

【0051】

【Effects or Advantage of the Invention】

As described above, the present invention provides a method for planning construction of the brick wall based on the DUP construction method, which can accurately, promptly and systematically determine the allocations of the bricks, the plates and the bolts and nuts before construction or during construction for constructing an arbitrary brick wall with use of a few standardized types of plates, which allows the bolts and nuts to be contained in the bricks, and which allows the tightening forces of the bolts and nuts to be distributed uniformly throughout the overall walls.

【Brief Description of the Drawings】

FIG.1 is a schematic cross sectional view showing a house provided with the brick walls made by the DUP construction method;

FIG. 2 is an illustration showing a plan, a front elevation, a cross-section taken along line I-I and a perspective view of a brick constituting an outer wall;

FIG. 3 is an illustration showing a plan, a front elevation, a cross-section taken along line II-II and a perspective view of another brick constituting the outer wall;

FIG. 4 is a vertical cross-sectional view showing a bricklaying process;

FIG. 5 is a vertical cross-sectional view of a brick wall structure constructed by the bricklaying process as shown in FIG. 4;

FIG. 6 is an illustration showing a perspective view and an

elevational view of the brick wall structure constructed by the bricklaying process as shown in FIG. 4;

FIG. 7 is an illustration showing a perspective view of a condition that metal plates are laid on an upper face of the brick wall as shown in FIGS. 5 and 6, and horizontal cross-sectional views of the bricks of an even number layer and an odd number layer;

FIG. 8 is a perspective view exemplifying an arrangement of the bricks in a corner part of the brick walls;

FIG. 9 is a perspective view exemplifying an arrangement of the bricks in a T-shaped connection of the brick walls;

FIG. 10 is a perspective view exemplifying an arrangement of the bricks surrounding an opening of a door or window;

FIG. 11 is an illustration showing plans which exemplifies an arrangement of the two-holes plates in the brick wall having the wall connection and the opening of the door or window;

FIG. 12 is an illustration showing plans which exemplifies an arrangement of the three-holes plates in the brick wall having the wall connection and the opening of the door or window;

FIG. 13 is an illustration showing a plan and a partially enlarged plan of a grid plane in which square grids constituting the odd number layer tightening grids and the even number layer tightening grids are alternately arranged lengthwise and crosswise;

FIG. 14 is an illustration showing grid plans which exemplifies a process of allocating the bricks and the metal plates to be located in the odd number layer;

FIG. 15 is an illustration showing grid plans which exemplifies a process of allocating the bricks and the metal plates to be located in the even number layer; and

FIG. 16 is a flowchart showing steps of operation for systematically setting allocations of the bricks and the plates, and a layout of the bolts.

【Explanation of Reference Numerals】

10 brick
20 hollow section
30 bolt hole
50 metal plate
53 bolt hole
60 bolt
70 nut
α odd number layer tightening grid
β even number layer tightening grid
γ reference grid

【Title of Document】 ABSTRACT

【Abstract】

【Object of the Invention】

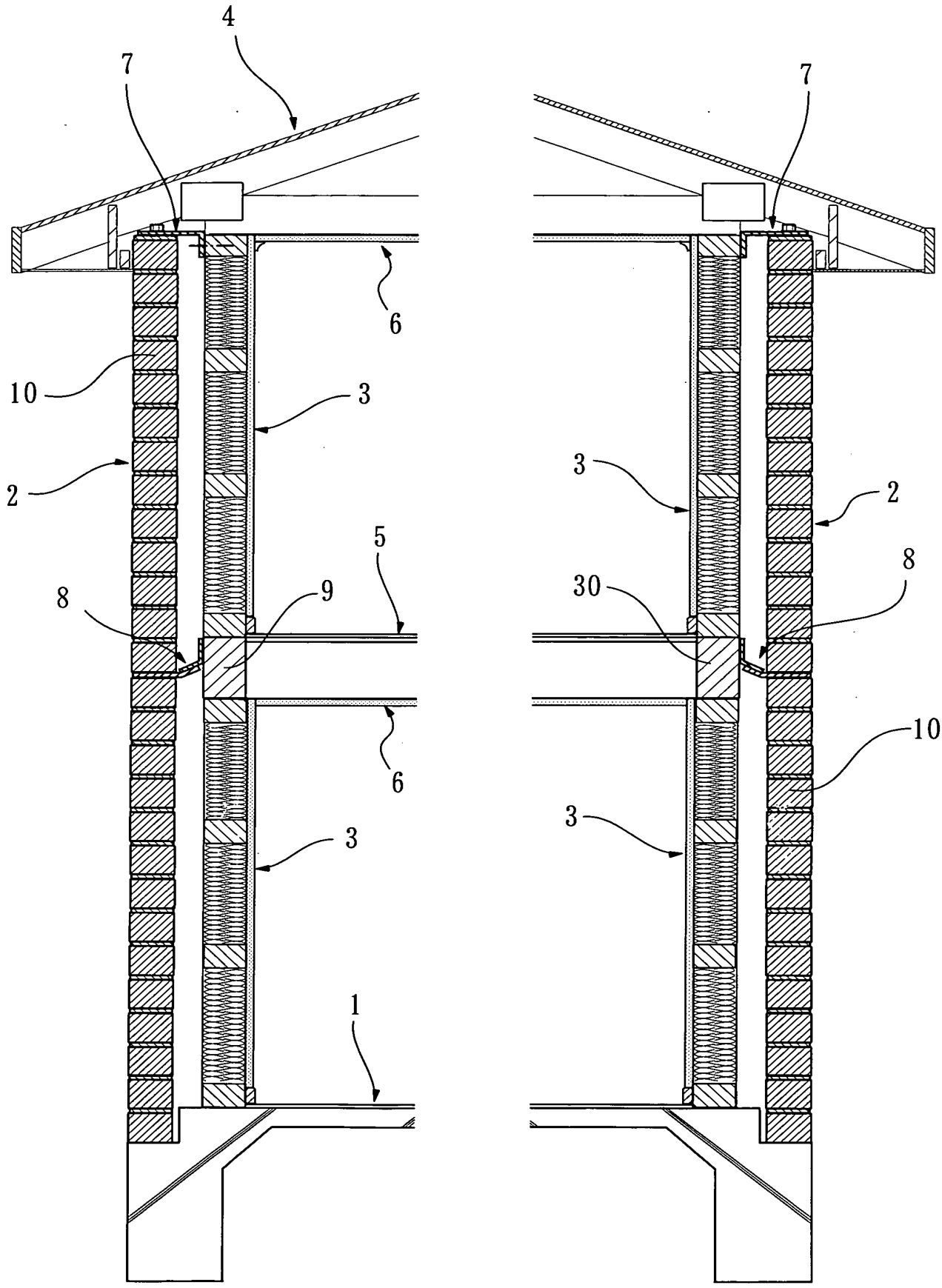
It is an object of the present invention to accurately, promptly and systematically determine allocations of DUP bricks, plates and so forth; standardize the plates; contain bolts-nuts in the bricks; and allow tightening forces of the bolts-nuts to be distributed uniformly throughout the overall wall.

【Summary of the Invention】

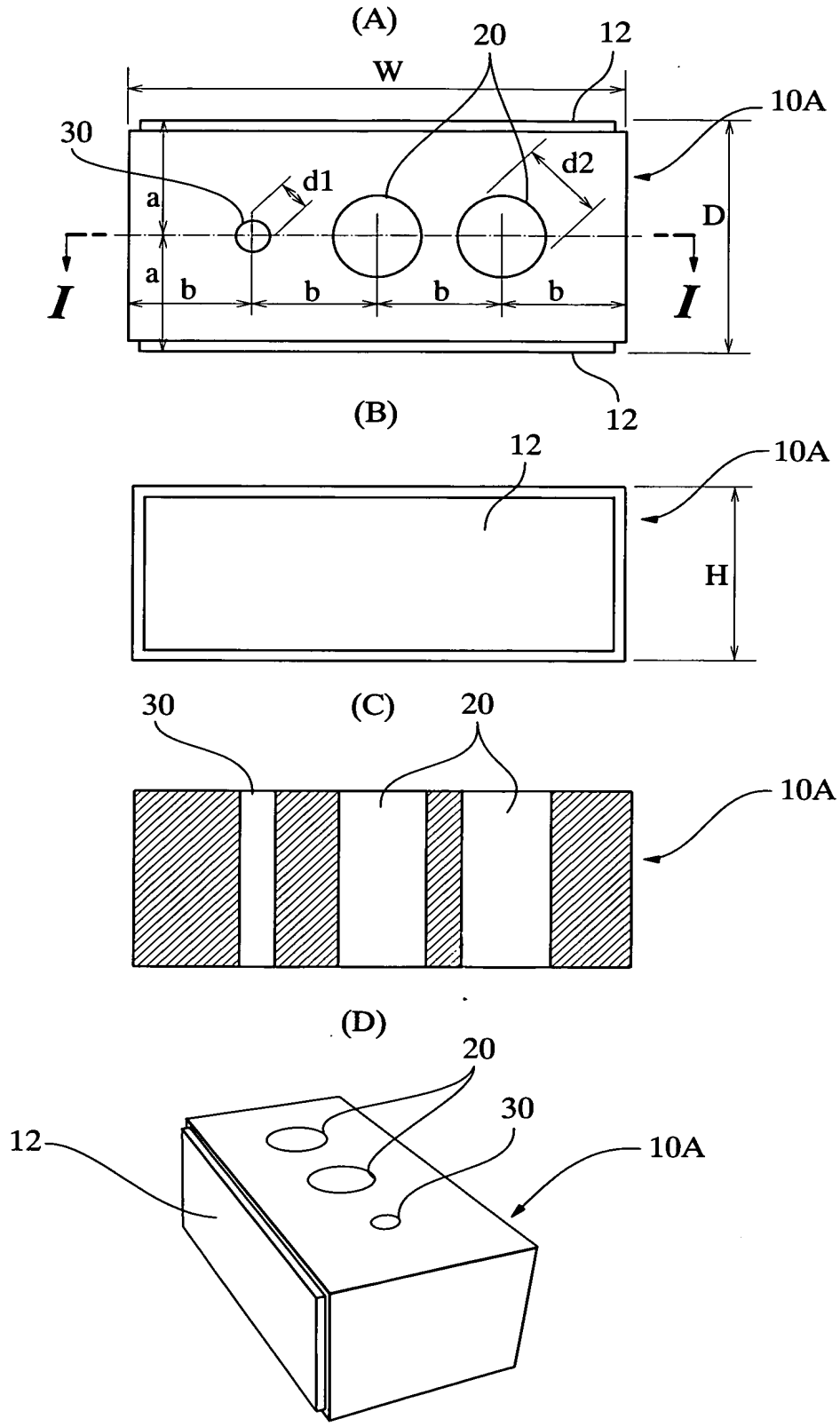
XY coordinate system forming square grids is specified, and odd number layer tightening grids (α) and even number layer tightening grids (β) are alternately set therein. The brick (10) at a corner part of the wall is positioned on a reference grid (γ) so that a first square half part of the brick having a bolt hole (30) matches the odd or even number layer tightening grid. The bricks in the odd or even number layer are successively arrayed from the reference grid. Metal plates (50) are disposed in such a manner that at least one bolt hole (53) of the metal plate in each layer is located on the odd or even number layer tightening grid.

【Selected Figure】 FIG. 14

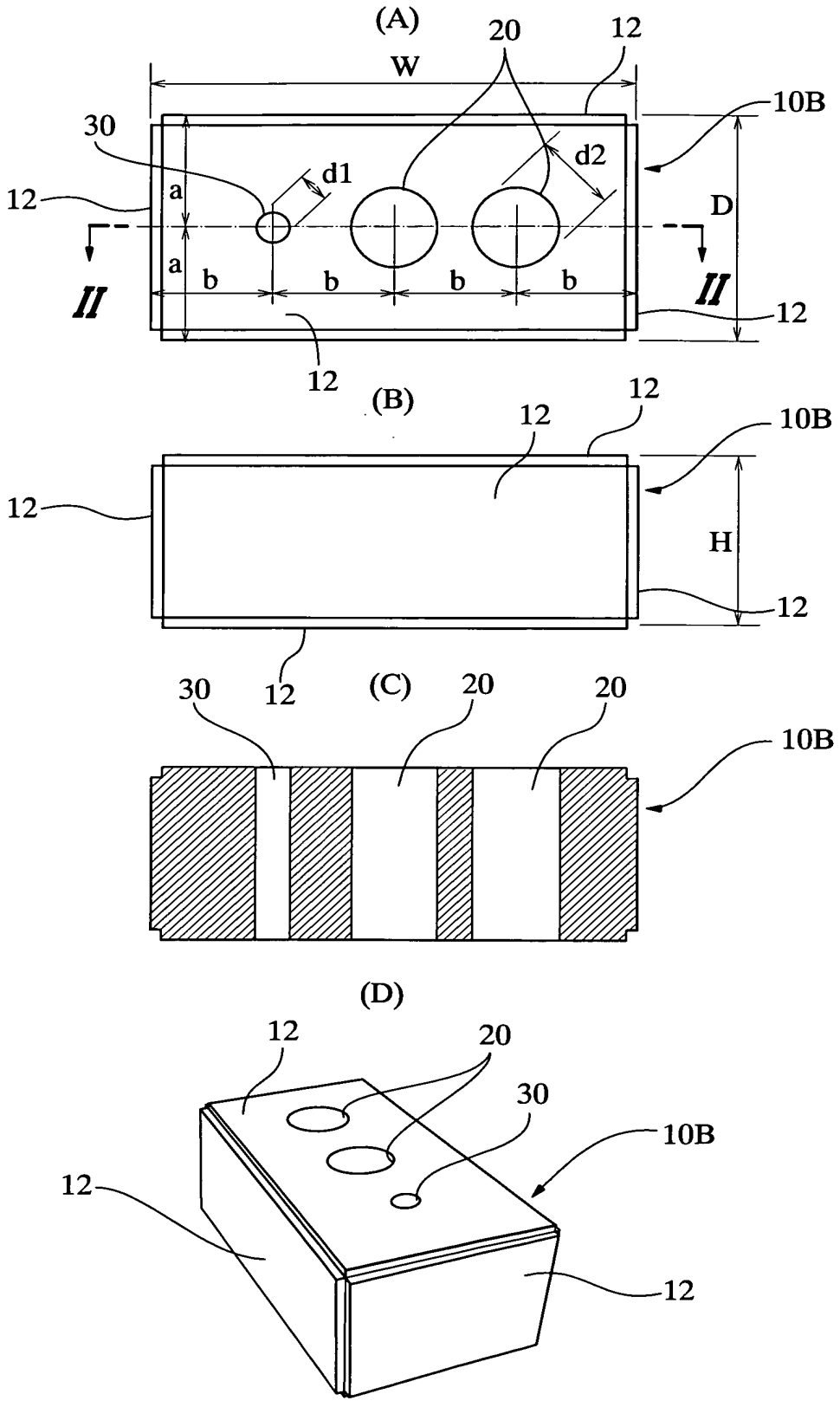
【 FIG. 1 】



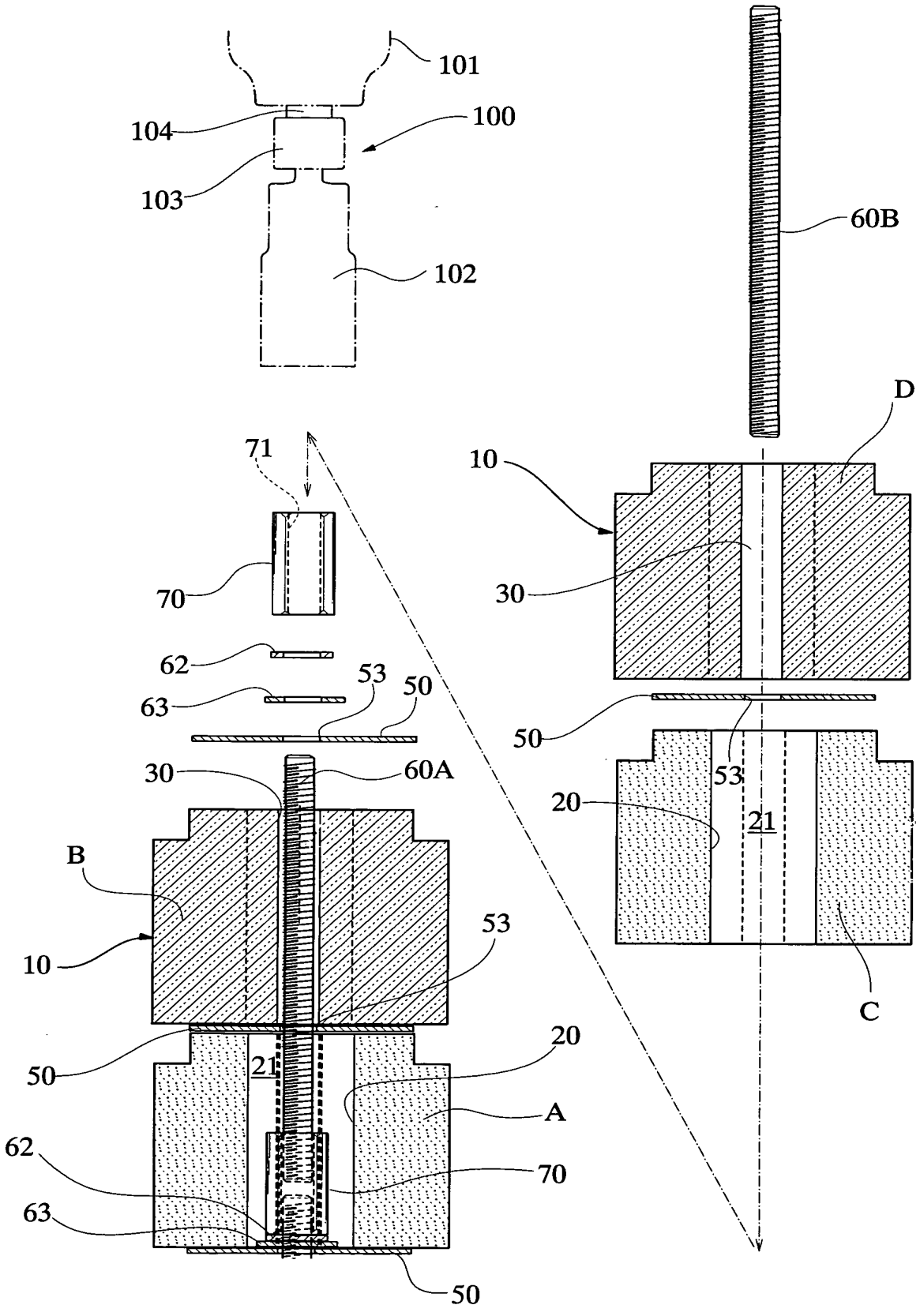
【 FIG. 2 】


(A)
20
12
W
10A
30
d1
d2
a
D
a
I
I
b
b
b
b
12
(B)
12
10A
H
30
(C)
20
10A
(D)
20
30
12
10A

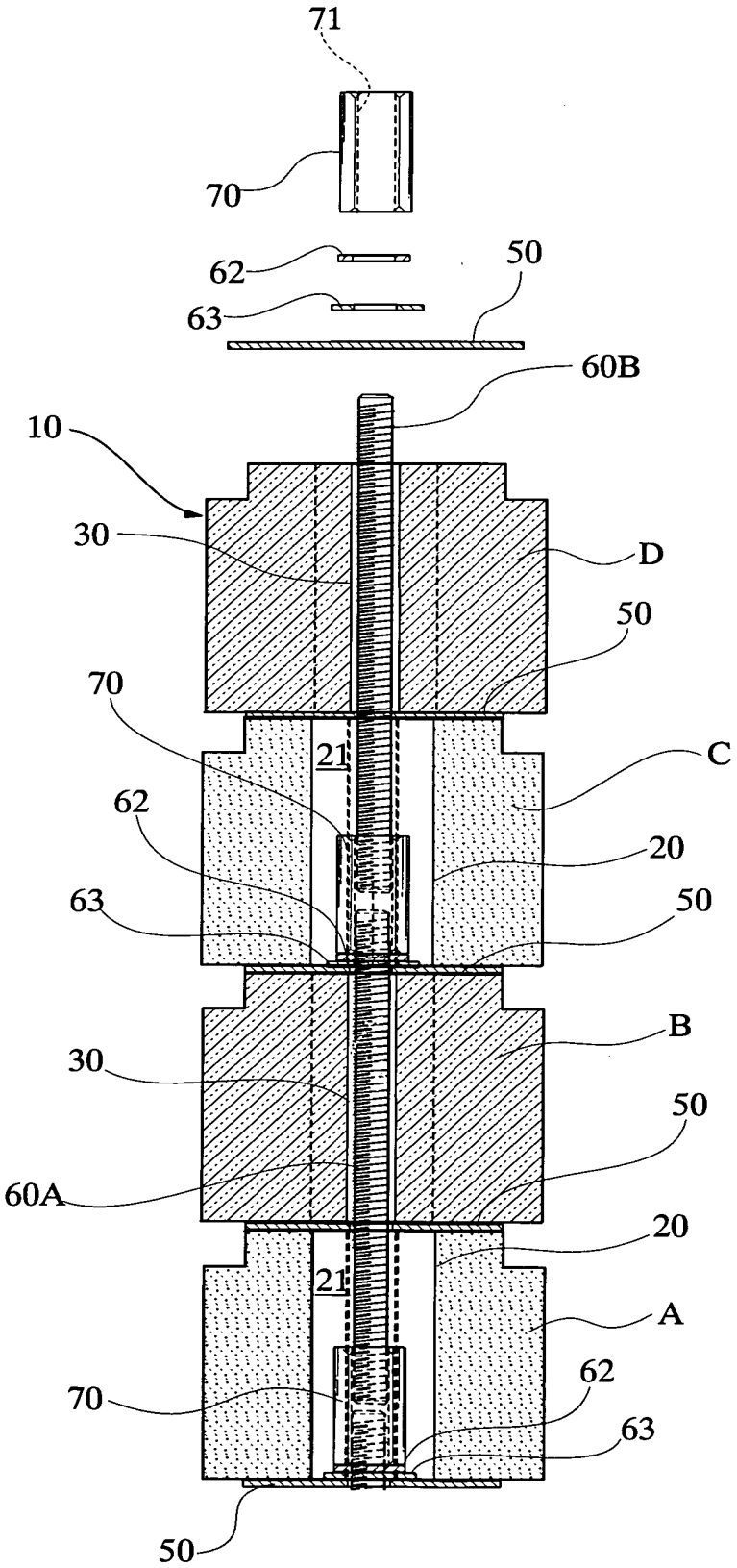
【 FIG. 3 】


(A)
20
12
W
10B
30
d1
d2
12
a
D
a
b
b
b
b
II
II
12
12
(B)
12
12
10B
12
H
12
30
12
(C)
20
20
10B
(D)
12
20
30
10B
12
12

【 FIG. 4 】

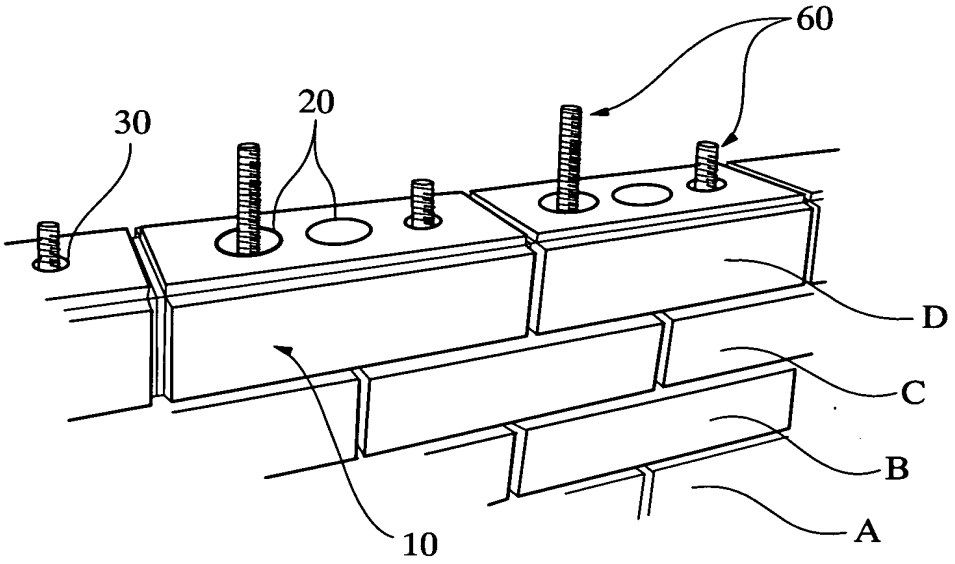

101
104
100
103
102
60B
D
71
10
70
30
62
53
50
63
50
53
30
60A
20
21
B
10
53
50
20
21
A
62
70
63
50
C

【 FIG. 5 】

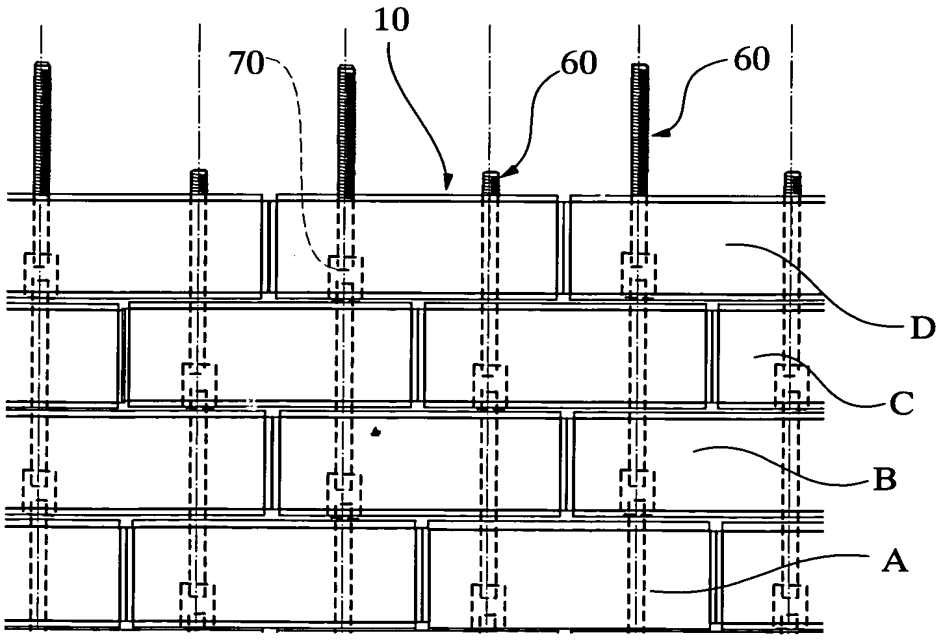

71
70
62
63
50
60B
10
30
D
50
70
21
C
62
20
63
50
B
30
50
60A
20
21
A
70
62
63
50

【 FIG. 6 】

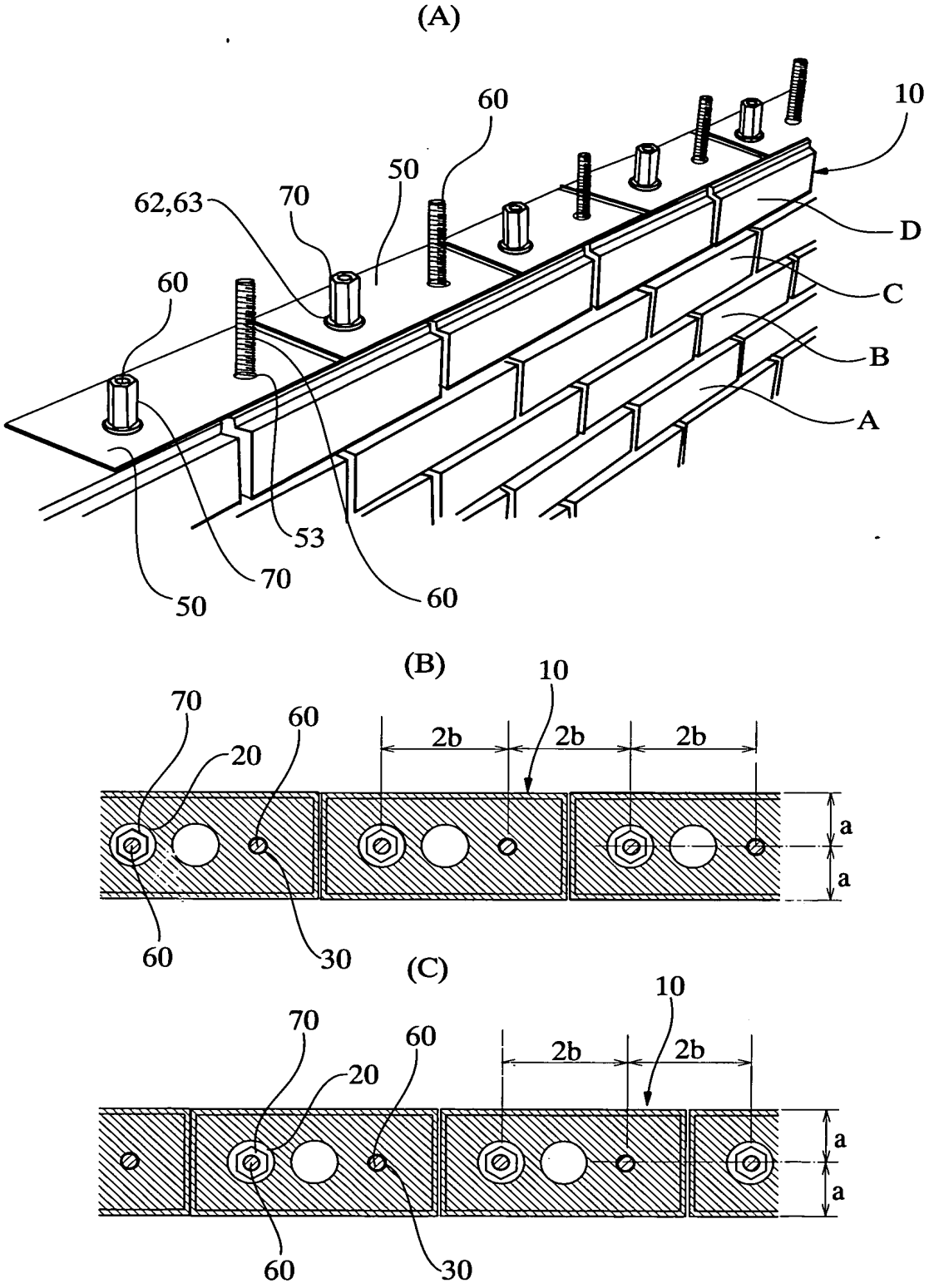
(A)



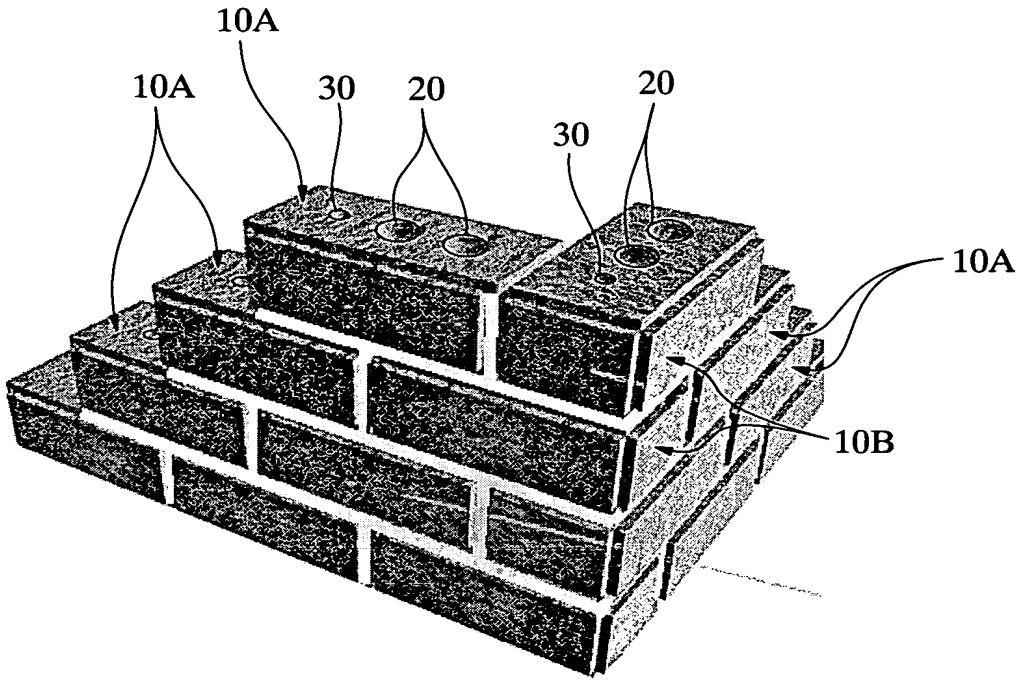
(B)



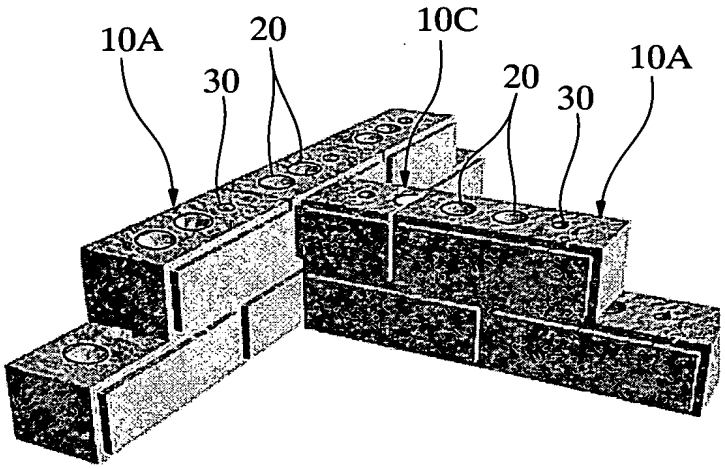
【 FIG. 7 】


(A)
60
10
50
62,63
70
D
60
C
B
A
53
70
50
60
(B)
10
70
60
2b
2b
2b
20
a
a
60
30
(C)
10
70
60
2b
2b
20
a
a
60
30

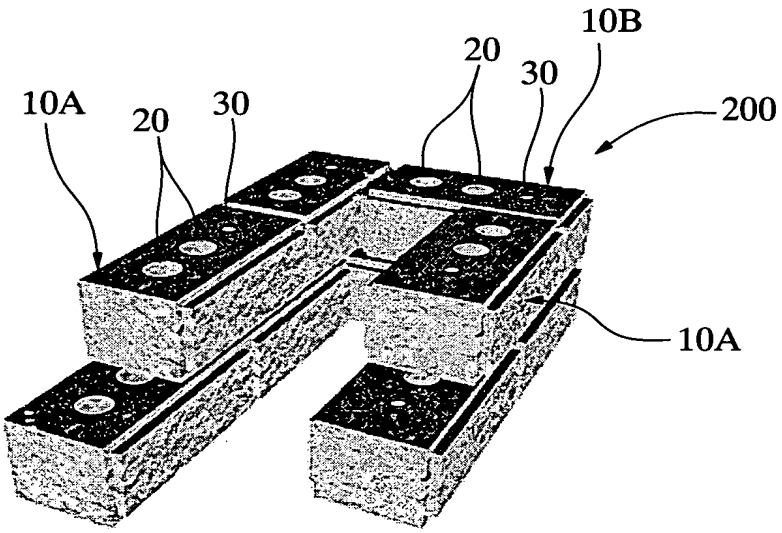
【 FIG. 8 】



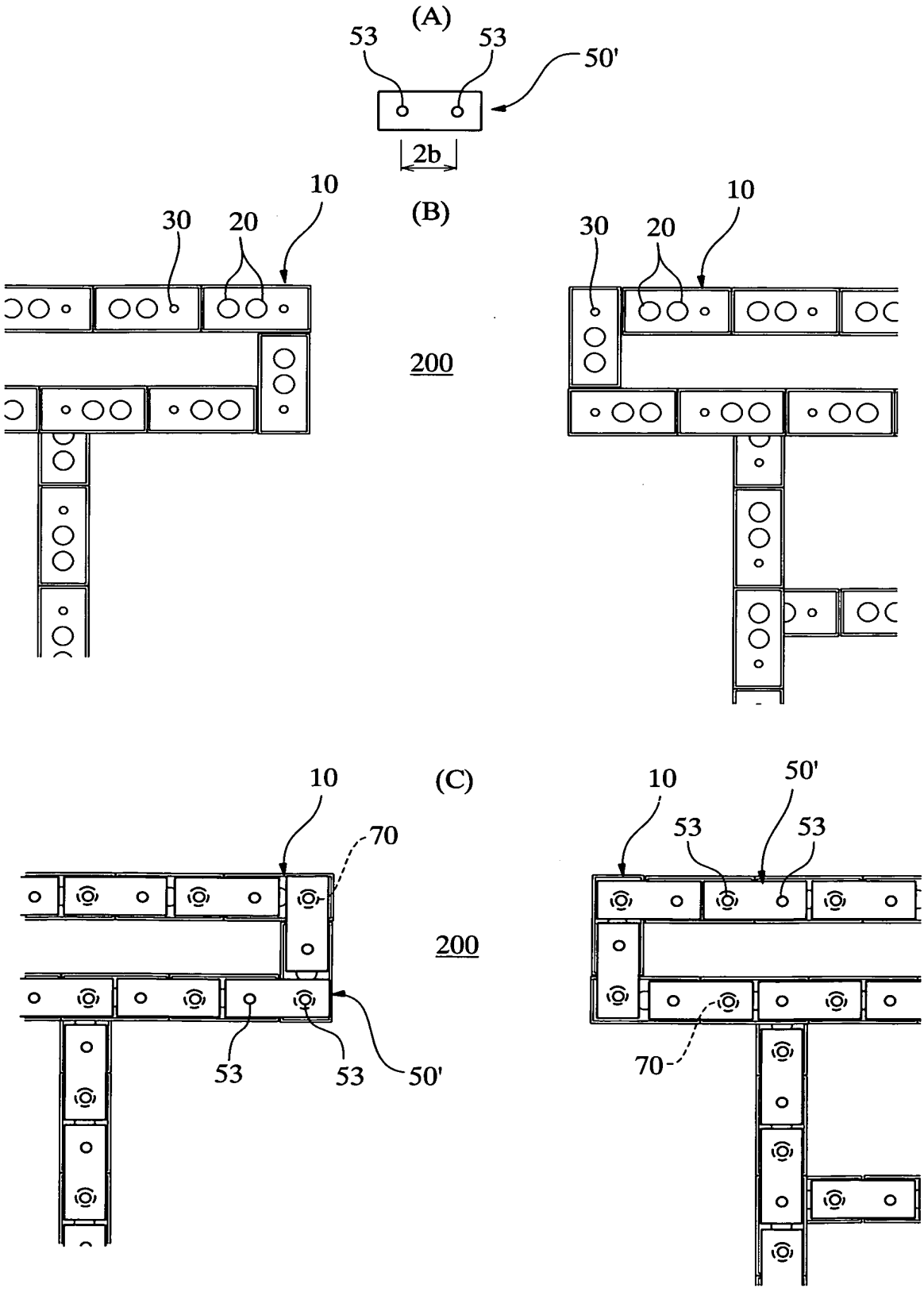
【 FIG. 9 】



【FIG. 10 】

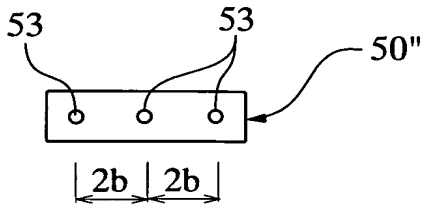


【FIG. 11】

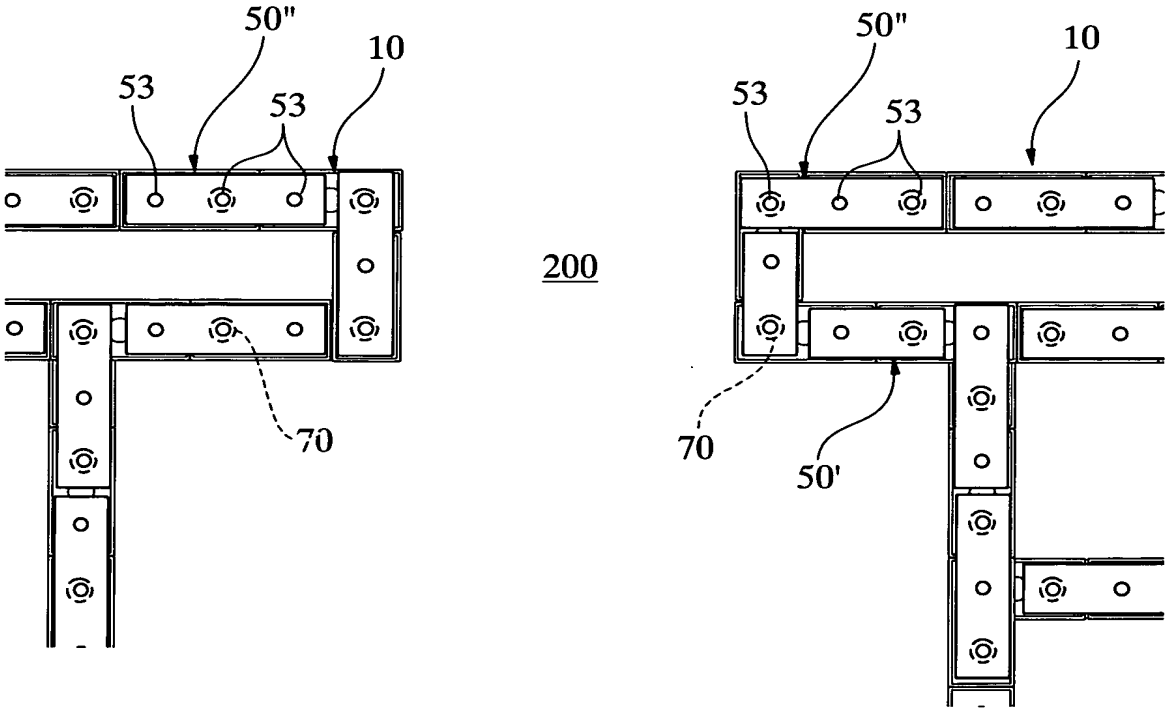


【FIG. 12】

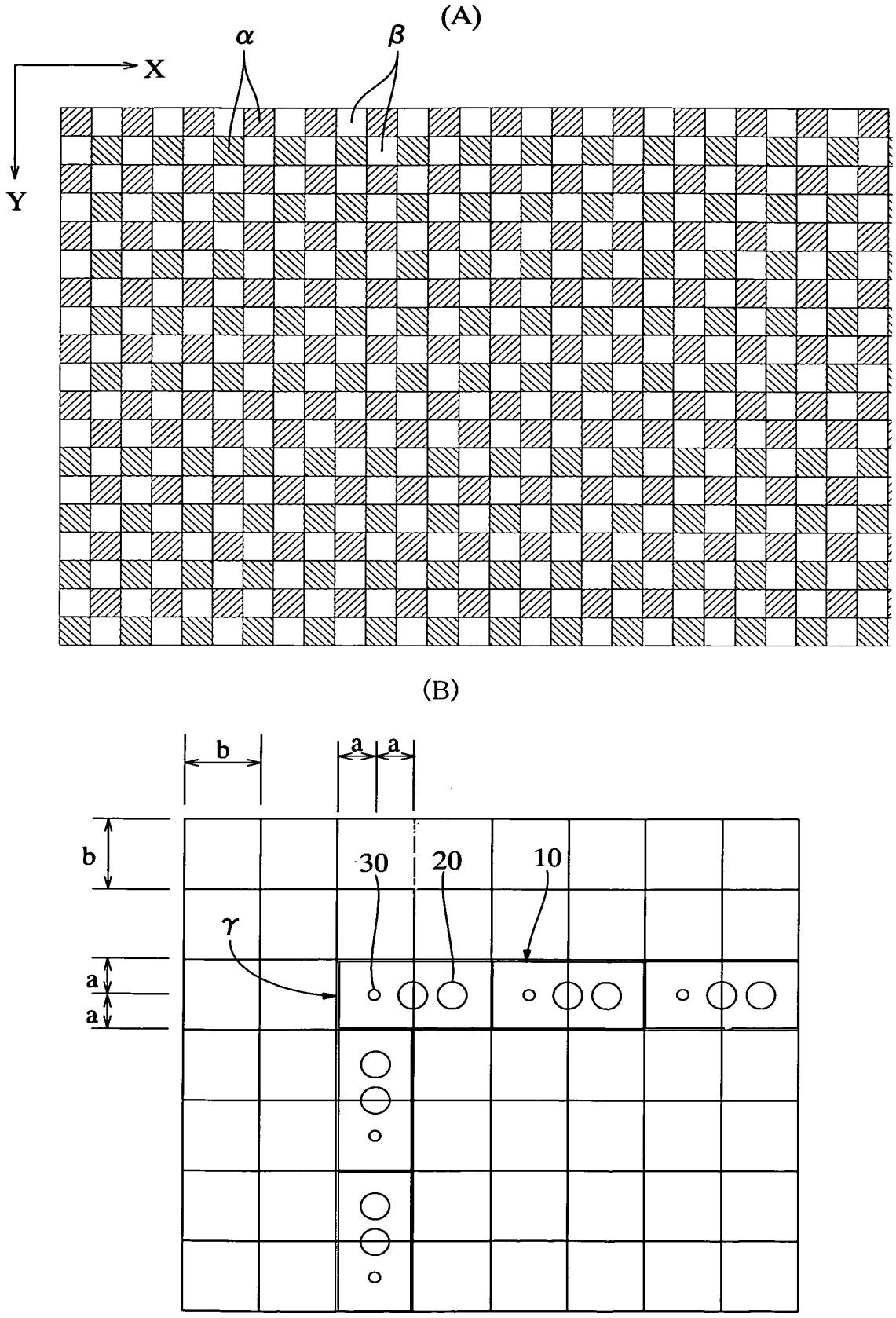
(A)



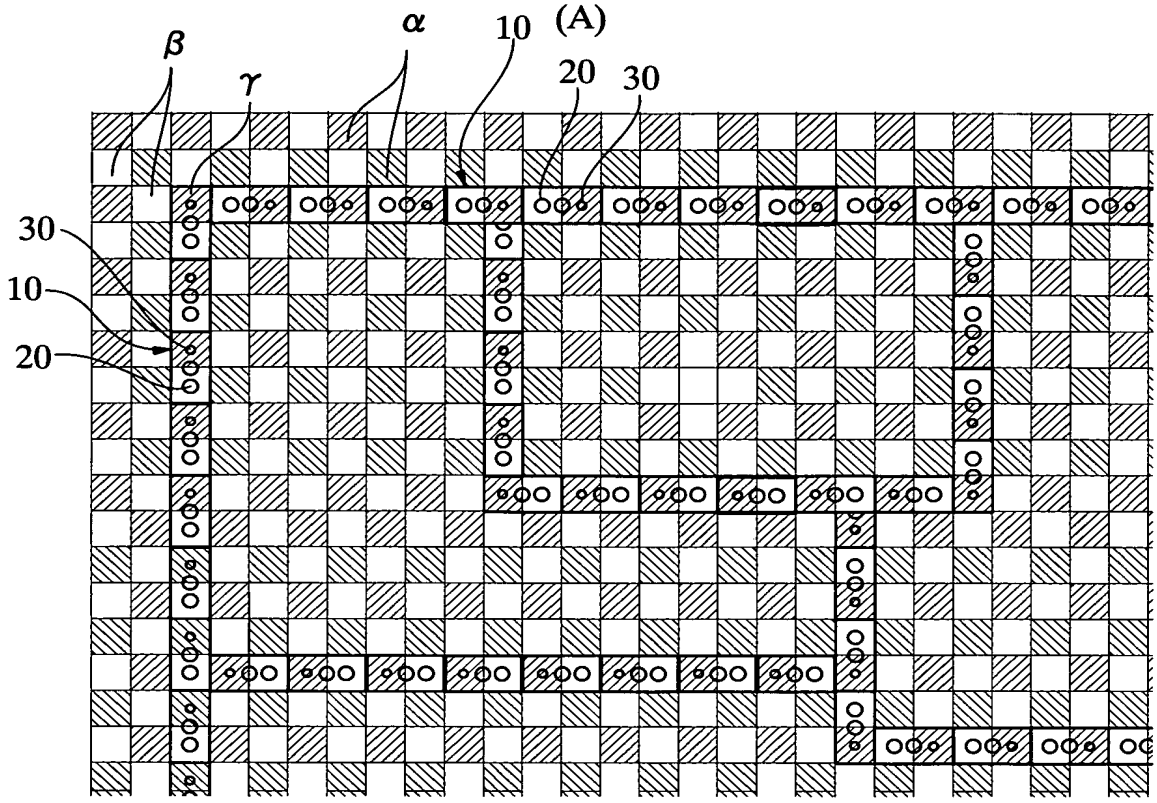
(B)

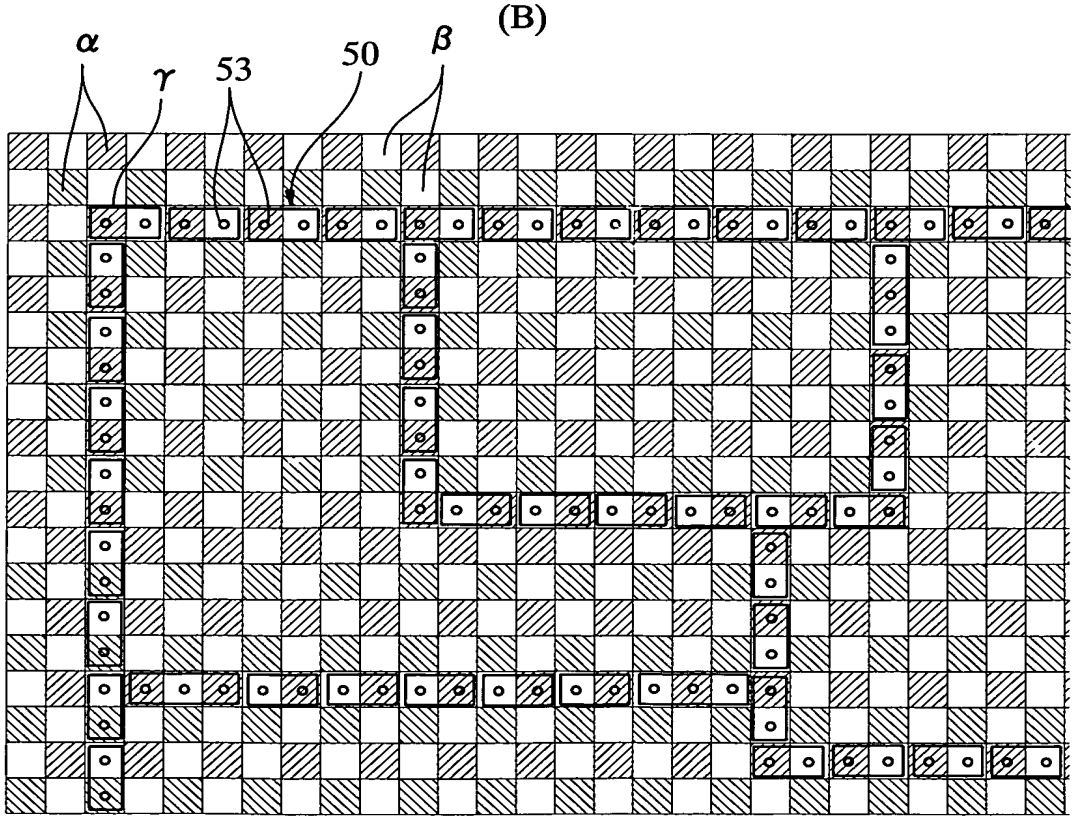


【FIG. 13】

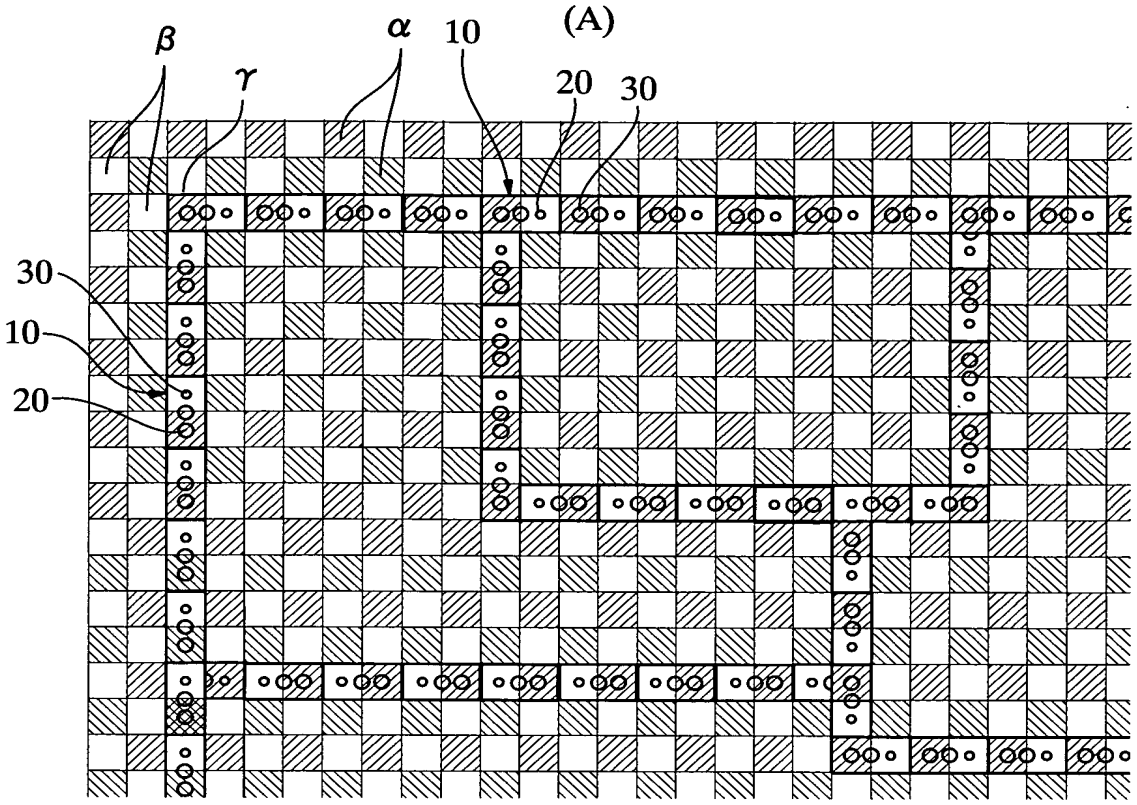


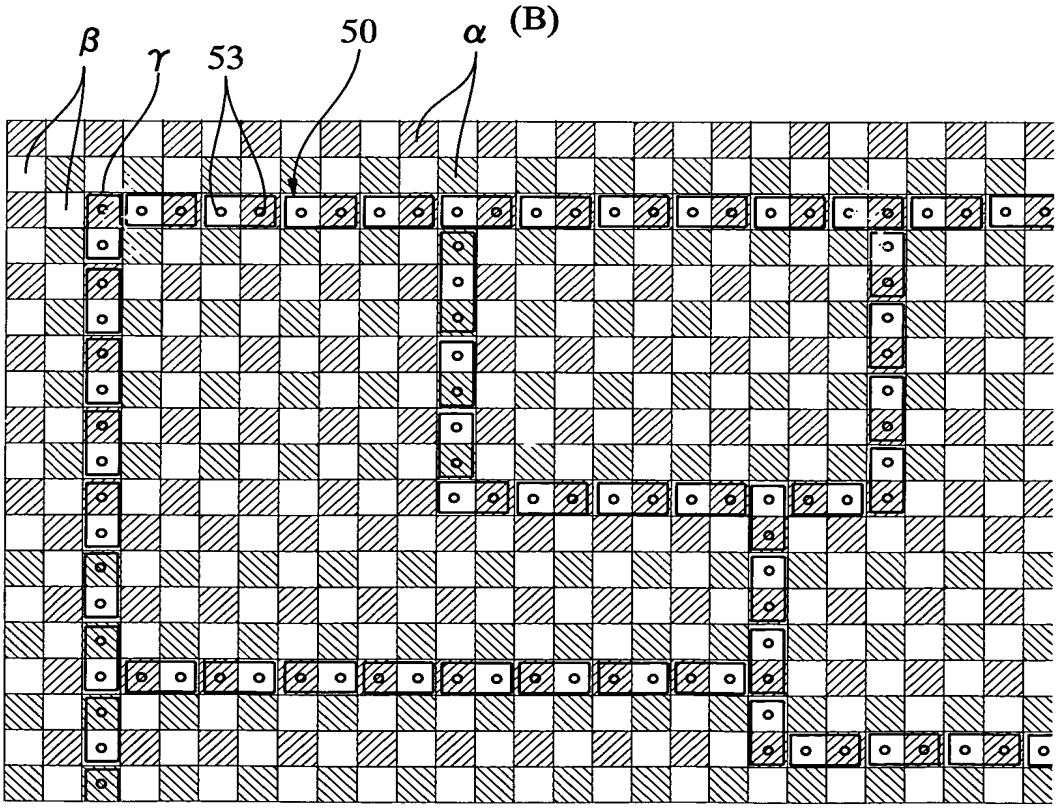
【 FIG. 14】



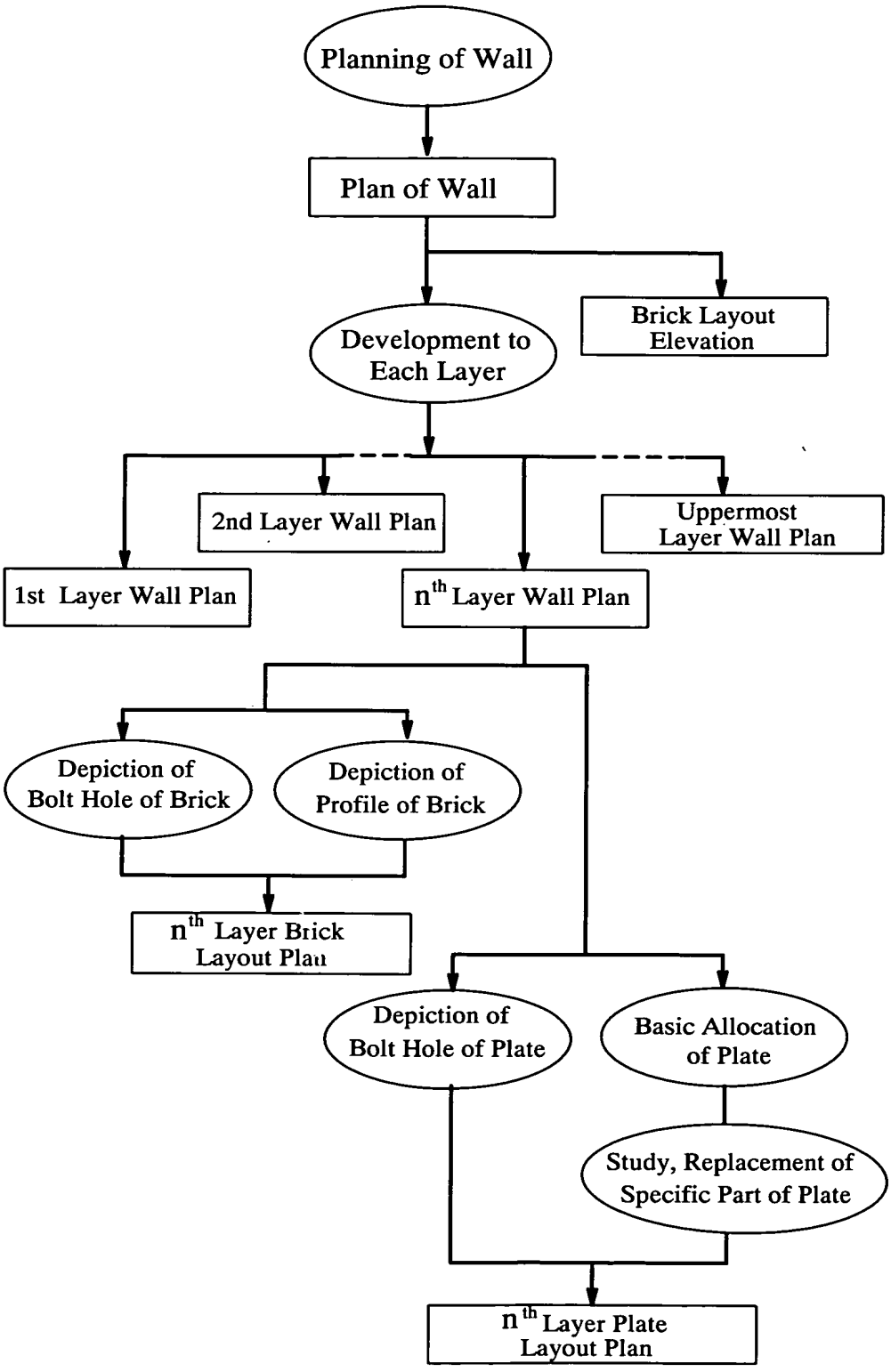


【FIG. 15】





【FIG. 16】


Planning of Wall
Plan of Wall
Development to Each Layer
Brick Layout Elevation
1st Layer Wall Plan
2nd Layer Wall Plan
nth Layer Wall Plan
Uppermost Layer Wall Plan
Depiction of Bolt Hole of Brick
Depiction of Profile of Brick
nth Layer Brick Layout Plan
Depiction of Bolt Hole of Plate
Basic Allocation of Plate
Study, Replacement of Specific Part of Plate
nth Layer Plate Layout Plan